USARIEM TECHNICAL NOTE

MERCURY SYSTEM USER'S GUIDE

Version: v1.11 Alpha

For Installed System:
MERCURY-Ranger Test Bed
6th Ranger Training Battalion
Camp James E. Rudder
Eglin Air Force Base, Florida

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13. ABSTRACT *(Maximum 200 words)*

The MERCURY-Ranger Test Bed integrates real-time weather information and meteorological models with a suite of physiologically-based thermal injury risk assessment models. It is a test-bed for command and control oriented modeling tools that are intended to help reduce the risk of heat and cold injury during Ranger training at Camp Rudder, Eglin AFB, Florida. The system has a Graphical User Interface (GUI) to simplify access to key functions and automatically archives all hourly weather information. This report provides specific instructions for using the various weather and predictive model functions incorporated in the latest version of MERCURY. It also describes network requirements and proper operating procedures for the Unix workstation computer that hosts the MERCURY software at Camp Rudder.

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risk assessment, heat stress, cold stress, real-time weather, terrain, predictive models, cold water immersion

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BACKGROUND

The current MERCURY system results from the close collaboration of U.S. Army Medical Research and Materiel Command/ Army Research Institute of Environmental Medicine (USAMRMC/ARIEM), the Army Research Laboratory /Battlefield Environment Directorate (ARL/BED), the Canadian Defence and Civil Institute of Environmental Medicine (DCIEM), the U.S. Air Force 46th Weather Squadron, Eglin AFB, the U.S. Air Force Combat Weather Facility, Hurlbert Field, and the U.S. Army 6th Ranger Training Battalion, Camp Rudder which has defined many of the user interface characteristics and features. Programming support for physiological models was provided by Science Applications International Corporation (SAIC) and initial communications programming support was obtained through a Defense Advanced Research Projects Agency (DARPA) contract with Bolt Beranak and Newman (BBN), Cambridge, MA.

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1. INTRODUCTION

1.1 OVERVIEW: The MERCURY-Ranger Test Bed integrates real-time weather information and meteorological models with a suite of physiologically-based thermal injury risk assessment models. It is a test-bed for command and control oriented modeling tools that are intended to help reduce the risk of heat and cold injury during Ranger training at Camp Rudder. The system has a Graphical User Interface (GUI) to simplify access to key functions. It automatically archives all hourly weather information.

1.1.1 Meteorological Models. Using data from the weather stations located across Eglin, MERCURY employs meteorological models to interpolate weather conditions at a 2.5 km spatial resolution across the 100 by 100 km field of view. The resulting grid of 1,600 cells, or sets, of weather information may be displayed directly as color coded map overlays or used as inputs into physiological models.

1.1.2 Physiological Models. The current physiological models are heat strain, cold survival time, and cold water immersion. Results from the heat strain and cold survival time models are viewed as color coded map overlays, but the cold water immersion model results are displayed as text and color coded point values for the three weather stations located along the Yellow River.

The POC at USARIEM, Natick Massachusetts is Mr. Bill Matthew DSN 256-5140. The local POC at USAF Combat Weather Facility, Hurlburt Field, is Mr. Gene Barnes, DSN 641-2766.

NOTICE

The MERCURY-Ranger Test Bed is still in model verification and validation phase. Displayed results are not to be construed as definitive nor should they substitute for common sense or judgements based on prior field experience with the Ranger trainee population.

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2. SYSTEM DESCRIPTION

2.2 MERCURY COMPUTER: The current MERCURY software runs on UNIX computers.

2.2.1 Computer. This is a Sun SPARCstation 5, running a UNIX operating system, and Sun's windowing environment, Openwindows, as distributed in Solaris version 2.5.1. The local (unregistered) name for this computer is *kahuna*. The Internet Protocol (IP) address, host ID, and Ethernet address are, for security reasons, provided to 6th Ranger Training Battalion in a seperate attachment. The system has a 20 inch color monitor, 96 Megabytes of internal RAM,

keyboard and optical mouse, 500 MB internal hard drive, and one external 2 GB capacity external disk drive.

2.2.2 Service Contract. There is a hardware maintainance contract (funded by USARIEM) in place on this system administered by the Air Force contract office at Eglin main base. **POC is MS Linda Boyette, 96CG/SCXR, Tel. 872-3171.**

2.3 INTERNET CONNECTION. The MERCURY system requires Transmission Control Protocol/Internet Protocol (TCP/IP) connections and an IP address.

2.3.1 Camp Rudder Connection. The system is connected to the Camp Rudder hub/router by a "twisted pair" (10 base-T) Ethernet cable.

2.4 WEATHER DATA FOR MERCURY. The MERCURY system requires access to hourly weather data.

2.4.1 RAWS Data. Using the Internet connection, **at 15 minutes past the hour**, the MERCURY computer automatically gets the most recent hourly weather station data from Eglin's Range Automated Weather Stations (RAWS) base station computer located at U.S. Air Force 46th Weather Squadron, Flight Operations Center, Eglin main base. **POC is Eglin's Chief Meteorologist, Mr. Ed Keppel, DSN 872-5960.**

3. GETTING STARTED

3.1 POWERING UP THE COMPUTER SYSTEM: UNIX workstations are fussy about the power- up sequence. Make sure the monitor, CPU, and external hard drive are plugged into the power supply then turn on the individual power switches in sequence as follows:

     1. Switch on external hard drive and wait at least 2 minutes for drive to "spin up" before continuing, then

     2. Switch on monitor

     3. Switch on CPU

The system will then automatically go through the "boot" process, and a long series of messages relating to system resources will appear on the screen. This will normally take several minutes. If the boot is successful the final line will be the login prompt.

3.2 LOGGING ON: Your user name is *ariem* and the password is as provided to 6th Ranger Training Battalion in a secure distribution . Below, bold is the prompt, italics is what you type.

     login: *ariem* press <Enter> key
     Password: ******* (you will not see this as you type it) press <Enter > key

3.3 STARTING THE WINDOW ENVIRONMENT: Below, bold is the prompt, italics is what you type.

kahuna{ariem} 1: *xinit* press <Enter> key

The Openwindow system will come up and now the mouse can be used.

3.4 STARTING MERCURY: Below, L is left mouse button, R is right mouse button and M is middle mouse button and, again, bold is the prompt, italics is what you type.

Move the mouse cursor to the white part of the window titled "cmdtool - bin/csh" and click L once. This will activate the prompt in that window .

kahuna{ariem} : *main* press <Enter> key

After a minute or so of processing time the initial MERCURY window should appear. The most recent hourly weather station data has been processed and is available at this time.

Figure 1. MERCURY display for Eglin AFB area. Upper 3-d image is static showing locati on of all weather stations. Lower grayscale image shows current active stations.
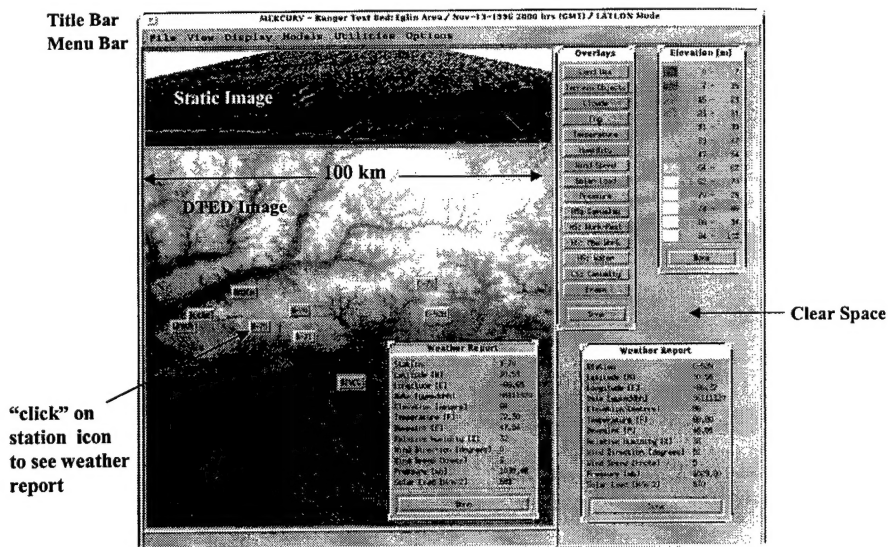
3.5 ABOUT THE MERCURY WINDOW: The initial MERCURY window consists of the following components:

3.5.1 Title Bar: This top border identifies the MERCURY software version, area being viewed, date time of weather information being shown, and the current geographic coordinate system (Lat/Lon or UTM) .

3.5.2 Menu Bar: This bar is a key part of MERCURY's Graphical User Interface (GUI) and lists the major categories of available functions: **File, View, Display, Models, Utilities,** and **Options**. The user activates menus in each category by using the mouse to point at the category word, **File** for example, and clicking L. The specific functions within each of these categories will be described in section 4.

3.5.3 Static 3-D image: This is simply a 3-dimensional representation of the geographical area with the weather station locations shown as red box and flag icons. This part of the MERCURY screen does not change and does not respond to the mouse.

3.5.4 DTED Image and Overlay Area: This is a gray scale image of Level 1 Digital Topographic Elevation Data (DTED) that provides the background for the weather station icons and all of the MERCURY overlay products. It is a roughly 100 X 100 Kilometer view of Eglin that includes Destin/ Fort Walton Beach. The most distinguishable features are Choctawhatchee Bay, and the Yellow River, Weaver River, and Shoal River drainages and the blue rectangular icons show the location of each active weather station. The image overlay area responds to L, R, or M mouse clicks in different ways that will be described in detail in section 3.

3.5.5 Clear Space Area: To the left of the 3-D and DTED images is clear space for displaying image overlay menus, color coded legends, and model input forms.

4. USING MERCURY FUNCTIONS

4.1 DTED Image Overlay Area: When MERCURY is started, the most recent weather information is loaded and available for display in the image overlay area using the mouse.

4.1.1 Weather Station Data: Clicking L on a weather station icon displays a pop-up pane showing the data for that station. Clicking L on "Done" erases it.

4.1.2 Interpolated Weather Data: Clicking L on any point in the DTED image area displays a pop-up pane showing the MERCURY "gridded" weather data for that location. Clicking L on "Done" erases it.

4.1.3 Mouse Cursor Position: Holding down M at any point in the DTED image displays a small white label showing either the Latitude/Longitude or UTM grid coordinates for cursor location. Releasing M erases the label.

4.1.4 Area Zoom: To zoom in on a small area of the DTED image, move cursor to what will be the upper left corner of the zoomed image. Hold down R and drag down and to the right (a faint

box showing limits of the zoom area will be visible as you do this). Release R to see the zoomed image. Click R once to return to the normal un-zoomed DTED image.

4.2 Menu Bar Functions:

4.2.1 File: Functions under File allow you to load different geographical areas, load current weather or weather for any month, day, and hour you choose, and it also allows you to exit the MERCURY program. Click L on File to see the list, then click L to select individual items in the list and sub list.

> **Load Selected Area**: **Eglin** is the default area- it is currently the only area with live weather.

> **Load Weather**:
> Usually you will select **Current Weather**. This updates the program with the latest weather data files. You will see a brief message in the bottom left of the MERCURY window that says "Loading New Weather" and the date/time information on the top title bar will change when loading and processing are complete.

> If you wish to see weather for a previous time choose **Selected Weather**. This opens 2 pop-up windows that appear one after the other:

> Year/Month pop-up window: This allows you to choose the year and month in YYMM format (For example 9705 is year 1997 and month 5, May). You can scroll through the available list of YYMM databases by clicking L on the small up/down triangles in the scroll bar to the right of the list. Move the cursor to the YYMM you want and click L to highlight your choice. Then move the cursor to the Select button at the bottom of the pop-up and click L.

> Day/Hour pop-up window: This allows you select the day of the month and specific hour of the day from the weather database in DDHH format (For example 0223 is the second day of the previously selected month at 23:00, 11pm). Make selections as in the previous pop-up window then click L on the Select button. This loads and processes the selected hourly weather. Remember all date/times are Zulu (GMT).

4.2.2 View: Functions under View allow you to zoom in or out or select a specified field of view for the DTED image and weather overlays.

> **Zoom In**: Select to zoom in by a pre-set factor

> **Zoom Out**: Select to zoom out by a pre-set factor

> **Center View**: Select to re-center image on a specific Lat/Lon or UTM grid coordinate.

Center View pop-up window. This asks user to type Latitude and Longitude or UTM coordinates for new image center location. Click L on appropriate text entry box   to activate input. Click L on OK when data has been entered in both boxes.

Set View: Select to specify minimum and maximum Lat/Lon or UTM boundaries for the DTED image.

 Set View pop-up window. This asks user to type Latitude and Longitude or UTM coordinates for new image boundaries. This requires the user to activate each of 4 text input boxes in turn and type the requested Lat/Lon or UTM data. Click L on OK when data has been entered in all four text boxes.

View Home: Select to reset to original full scale view.

4.2.3 Display: The key function under Display allows you to make the primary overlay menu visible in the clear space to the left of the DTED image.

Elevation Overlays: Select Elevation Overlays to display the **Overlays** menu. This is probably the most important interface menu and should be visible whenever MERCURY is running.   The first four items in Overlays (Land Use, Terrain Objects, Clouds, and Fog) are not activated in this version of MERCURY. The remaining 10 overlay categories are functional as described below.

NOTE: Once a color overlay has been displayed, select Erase before attempting to display another color overlay. For example, Erase a Humidity overlay before selecting a Solar Load overlay.

Overlays

Temperature: This overlay divides the range in temperatures (°F) across the region into 8 color coded categories, maps them onto the DTED image, and also displays a legend specifying the temperature range for each color.

Figure 2. MERCURY display showing air temperature overlay.

"click" on
Temperature
button to see
overlay
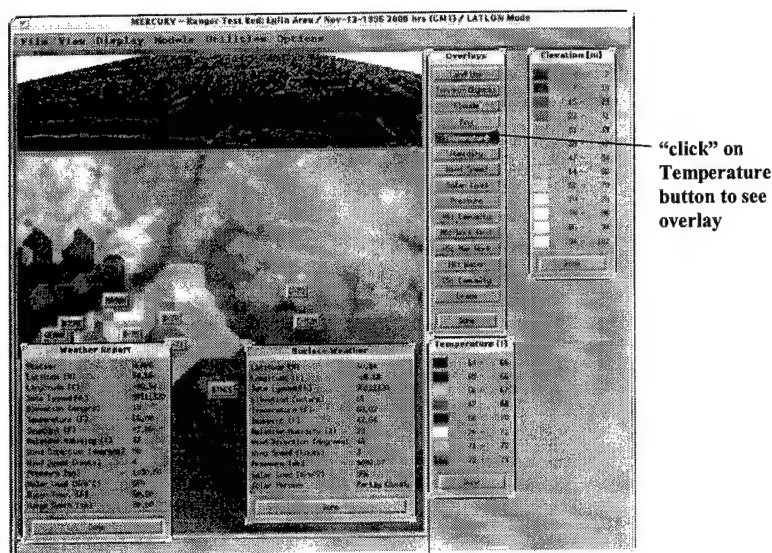
Humidity: This overlay divides the range in relative humidity (%) across the region into 8 color coded categories, maps them onto the DTED image, and also displays a legend specifying the humidity range for each color.

Wind Speed: This overlay divides the range in wind speed (Knots) across the region into 8 color coded categories, maps them onto the DTED image, and also displays a legend specifying the wind speed range for each color.

Solar Load: This overlay divides the range in solar load (Watts/m^2) across the region into 8 color coded categories, maps them onto the DTED image, and also displays a legend specifying the solar load range for each color.

Pressure: This overlay divides the range in atmospheric pressure (Millibars) across the region into 8 color coded categories, maps them onto the DTED image, and also displays a legend specifying the atmospheric pressure range for each color.

*Note: The following **Overlays** items do not become active until the Heat Stress or Cold Survival models have been run. Section 3.3 provides detailed information on running the models.*

HS: Casualty: If the Heat Stress model has been run, this overlay maps the color coded heat casualty risk (% Heat Casualties) severity onto the DTED image. This is potential heat casualty risk. It assumes Work/Rest, Max Work, and Water

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requirements guidelines shown below are NOT implemented. Color codes are green for low risk, amber for moderate risk, and red for high risk conditions.

Figure 3. MERCURY display showing heat strain model inputs and casualty risk overlay for MOPP4.
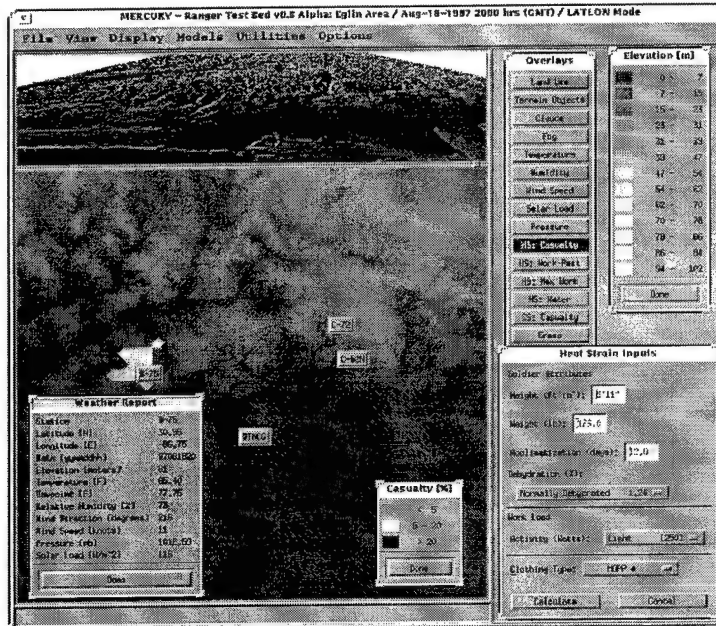
HS: Work-Rest: If the Heat Stress model has been run, this overlay maps the color coded optimal work-rest cycle limits (Minutes of Work per Hour) onto the DTED image. Color codes are green for low risk, amber for moderate risk, and red for high risk conditions.

HS: Max Work: If the Heat Stress model has been run, this overlay maps the color coded maximum safe work time limits (Minutes) onto the DTED image. Note that this product assumes that after the safe work time limit has been reached, the soldiers will rest in cool shade for several hours. Color codes are green for low risk, amber for moderate risk, and red for high risk conditions.

HS: Water: If the Heat Stress model has been run, this overlay maps the computed water loss (sweat) rate (Quarts per Hour) onto the DTED image. Color codes are green for low risk, amber for moderate risk, and red for high risk conditions. (Your body cannot absorb much more than 1.3 quarts per hour and drinking more than that amount per hour is potentially dangerous.)

HS: WBGT: If the Heat Stress model has been run, this overlay maps the computed WBGT index. Color codes are green for Cat 1, yellow for Cat 2, orange

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for Cat 3, red for Cat 4, and black for Cat 5. (Rely on your local measurements until we make certain these computed WBGT readings are accurate.)

CS: Casualty: If the Cold Survival model has been run, this overlay maps the time (hours) it would take for the internal body temperature of an inactive soldier to reach a lethal threshold of 86 $^\circ$F onto the DTED image. Note that this product is based on air temperatures and dry clothing and has limited applicability in the Eglin environment. Color codes are green for low risk, amber for moderate risk, and red for high risk conditions.

4.2.4 Models: There are currently three model choices under Models: Heat Strain Calc, Cold Survival Calc, and Cold Water Calc. Selection of any one of these three will cause a user input pop-up window to appear.

Note: The fourth option does not apply to Eglin, and should always read: WPSM Roll is OFF . (if it reads: WPSM Roll is ON, simply click L on that line to toggle back to: WPSM Roll is OFF)

Heat Strain Calc: Select Heat Strain Calc to start the heat strain prediction model.

Heat Strain Inputs pop-up window: This window contains "default" parameters that you can change to more accurately reflect the mission and troop status. Generally these inputs should represent "average" characteristics for the individuals in the unit.

Height (ft'in"): If you wish to change default height place mouse cursor on white text window and click L, then type in new value in feet and inches. Example: *5'11"*

Weight (lb): If you wish to change default weight place mouse cursor on white text window and click L, then type in new value in pounds. Example: *163.0*

Acclimatization (days): This is your estimate of how many days the troops have been working under hot conditions. After about 12 days they have most of the physical benefits of the acclimatization process. If you wish to change default acclimatization days, place mouse cursor on white text window and click L, then type in new value in whole days. Example: *5*

Dehydration (%): This can usually be set at 1.24 % unless the troops are known to have been without access to water. If you wish to change the default, click L once on the bar to see a pop-up menu then click L again on your choice to select it.

Activity (Watts): This is your rough estimate of the physical effort the troops are expending during the mission. Heavy work would be marching uphill (5% grade) with a 100 lb pack and medium would be marching on paved level road with that same load. If you wish to change the default, click L once on the bar to see a pop-up menu then click L again on your choice to select it.

Clothing Type: In most cases at Eglin, the clothing type selection should be MOPP 0 (BDU). If you wish to change the default, click L once on the bar to see a pop-up menu then click L again on your choice to select it.

Calculate: Click L on the Calculate button to run the model. When "Done Calculating Heat Strain Model" appears at bottom left of MERCURY screen, the four Heat Stress (HS:) output products listed under the Overlays menu can be selected for display.

Cancel: Click on the Cancel button to make the **Cold Survival Inputs** pop-up window disappear.

Cold Survival Calc: Select this item to start the cold survival time prediction model. It is important to understand that this model applies only to situations where the individual is resting quietly or is injured and cannot raise his metabolic rate by physical activity. Also, because the endpoint in this model is essentially death from hypothermia, it is not appropriate for injury prevention in training environments.

> Cold Survival Inputs pop-up window: This window contains "default" parameters that you can change to more accurately reflect the mission and troop status. Generally these inputs should represent "average" characteristics for the individuals in the unit.
>
> **Height (ft'in"):** If you wish to change default height place mouse cursor on white text window and click L, then type in new value in feet and inches. Example: *5'11"*
>
> **Weight (lb)**: If you wish to change default weight place mouse cursor on white text window and click L, then type in new value in pounds. Example: *163.0*
>
> **Body Fat (%):** This is your estimate of the % body fat for the troops. Ranger students we have seen at Camp Rudder measured from 8 to 18% body fat. If you wish to change default % Body Fat, place mouse cursor on white text window and click L, then type in new value. Example: *14.0*
>
> **Insulation:** This refers to the clothing insulation and should be set to 1.2 for this model under dry conditions.
>
> **End point (hr):** This sets how long the model will track body temperatures under current weather conditions. This should typically be set to 12.
>
> **Calculate**: Click on the **Calculate** button to run the model. When "Done Calculating Cold Strain Model" appears at bottom left of MERCURY screen, the **CS: Casualty** output product listed under the **Overlays** menu can be selected for display.
>
> **Cancel:** Click on the Cancel button to make the **Cold Survival Inputs** pop-up window disappear.

Cold Water Calc: Select this item to start the cold water immersion prediction model. It is important to understand that this model uses water temperature and depth information from specific weather stations along the river. Therefore results should not be extrapolated to river locations more than 1 or 2 kilometers from the closest station location.

Figure 4. MERCURY display showing cold water immersion model inputs and outputs for the three stations along the Yellow River.
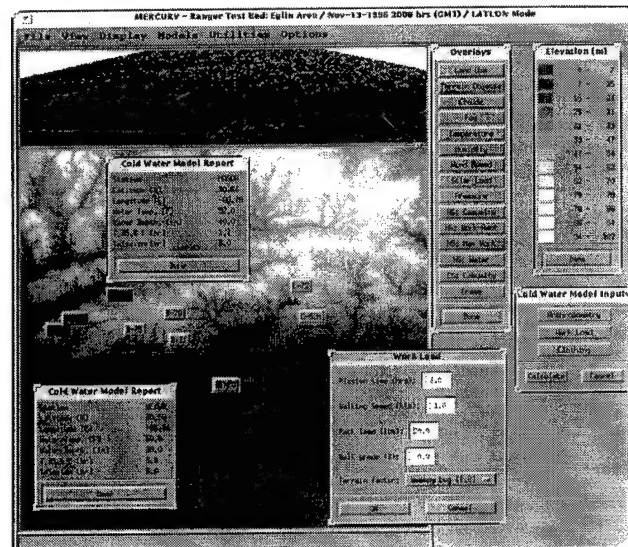
Cold Water Model Inputs pop-up window: This window contains the Calculate and Cancel buttons as well as three buttons for sub-menu categories of inputs: Anthropometry, Work Load, and Clothing. Each of these will pop-up its own sub-menu.

Anthropometry sub-menu: Generally these inputs should represent "average" characteristics for the individuals in the unit.

Height (ft'in"): If you wish to change default height place mouse cursor on white text window and click L, then type in new value in feet and inches. Example: *5'11"*

Weight (lb): If you wish to change default weight place mouse cursor on white text window and click , then type in new value in pounds. Example: *163.0*

Body Fat (%): This is your estimate of the % body fat for the troops. Ranger students we have seen recently at Camp Rudder measured from 8 to 18% body fat. If you wish to change default % Body Fat, place mouse cursor on white text window and click , then type in the new value. Example: *11.0*

Age: For the Ranger students you would click on the left diamond shaped button that selects the **Young (25)** category.

Metabolic Capacity: This relates to body energy stores: Click on the bar shaped button and for Ranger students select **Moderately Depleted (50%).**

OK: Click on the OK button to make the Anthropometry pop-up window disappear, activate any changes you have made and return to the Cold Water Model Inputs pop-up.

Cancel: Click on the Cancel button to make the Anthropometry pop-up window disappear and return to the Cold Water Model Inputs pop-up.

Work Load sub-menu: These inputs should represent an "average" estimate based on mission and terrain.

Mission Time (hrs): This is your best estimate of the length of time the Ranger students are likely to be in the water. If you wish to change the default Mission Time , place mouse cursor on white text window and click , then type in new value. Example: *3.0*

Walking Speed (kts): This is your best estimate of how fast the Ranger students are moving. The present input units are knots (kts) but a miles per hour estimate is OK here. For example if you estimate they are moving at 2 mph, type *2.0* in the text window.

Pack Load (lbs): This is your best estimate of the load the Ranger students are carrying. (includes the weight of clothing, weapons, and ammunition). For example if you estimate they are carrying 100 pounds, type *100* in the text window.

Walk grade (%): This is your best estimate of the average grade along the route the Ranger students are traveling. For example if you estimate an average grade of 3% , type *3.0* in the text window.

Terrain factor: This is a selection based on terrain type. Click on the bar shaped button and select the appropriate category.

OK: Click on the OK button to make the Work Load pop-up window disappear, activate any changes you have made and return to the Cold Water Model Inputs pop-up.

Cancel: Click on the Cancel button to make the Work Load pop-up window disappear and return to the Cold Water Model Inputs pop-up.

Clothing sub-menu: These selections are for Clothing and non-immersed clothing Wetness.

Clothing: There is presently only one uniform, BDU, and that is the default.

Wetness: Select clothing wetness from the button bar. For example, if it has been raining for a while select high (2700).

OK: Click on the OK button to make the Work Load pop-up window disappear, activate any changes you have made and return to the Cold Water Model Inputs pop-up.

Cancel: Click on the Cancel button to make the Work Load pop-up window disappear and return to the.

Calculate: Click on the Calculate button in the pop-up to run the model. When "Done Calculating Cold Water Immersion Model" appears at bottom left of MERCURY screen, the output products for each reporting river station will be visible as a color coded icon: Green indicates minimal risk, amber indicates go with caution, and red means high risk . Click on station icon to see listed outputs which consist of: station ID, Lat/Lon, water temp and depth, as well as predicted time to a $35.5\,^{\circ}\,C$ ($95.9\,^{\circ}\,F$) body core temperature.

Cancel: Click on the Cancel button to make the Cold Water Model Inputs pop-up window disappear.

4.2.5 Utilities There are currently three menu choices under Utilities: Data Export, Print Screen, and Report Generator.

Data Export: Clicking this option produces a pop-up menu that requests a file name to save current data (This may have been removed from Camp Rudder version)

Print Screen: Clicking on this option prints the current MERCURY window as a color Postscript image on the color printer (if the printer is connected to the parallel port!).

Report Generator: Clicking on this option prints a black and white report of current weather data from all the stations on the color printer (if the printer is connected to the parallel port!)

4.2.6 Options. There are currently four menu choices under Options: About MERCURY, Toggle Stations,Toggle Elevation Legend , and Set Coordinate Mode.

About MERCURY: Clicking this option produces a pop-up text pane listing contributors to the MERCURY system and some of its limitations.

Toggle Stations: Clicking on this option makes the weather station icons appear on the DTED image if they are not already there or disappear if they are currently visible.

Toggle Elevation Legend: Clicking on this option makes the DTED elevation legend appear if it is not already there or disappear if it is currently visible.

Set Coordinate Mode: Clicking on this option produces a small pop-up menu to select either Lat-Lon (Latitude Longitude) or UTM (Universal Transverse Mercator) coordinates for all MERCURY display/printed products.

5. STOPPING MERCURY AND POWERING DOWN THE COMPUTER

5.1 Procedures: Normally MERCURY will run continuously 24 hours a day, every day. There may be situations however, such as planned or unplanned power outages, that will require complete system shut down.. Six steps are required, and these are described in detail in sections 5.1.1 through 5.1.6.

5.1.1 Quit MERCURY: Click on File in the top menu bar of the MERCURY screen and then click on Quit. The MERCURY window will disappear.

5.1.2 Exit Window System: Move the cursor to any clear space with the blue background and click the <u>Right</u> mouse button to pop up the Workspace menu, drag the cursor down to Exit then let up. The Pop up asks you to confirm by clicking Left mouse button on Exit. Do this, and the window system will disappear.

5.1.3 Log out as ariem: You will have a white screen with the ariem user prompt. To log out as user ariem:

> **kahuna{ariem} 1:** *exit* <enter>

You should now see the **login** prompt.

> *Note: The computer's UNIX operating system is still running and must be shut down before turning off power. Follow steps listed in 4.1.4 to 4.1.6 to complete the shutdown.*

5.1.4. Log in as root: You must be user **root** to shutdown the operating system and this requires a root password [as provided to 6th RTBn]. To log in as root:

> **login:** *root* <enter>
> **Password:** ******** (you will not see it as you type) <enter>

You should see the # prompt, which means you now have authority to shutdown the operating system.

5.1.5 Stop the UNIX Operating System: To shutdown the operating system:

> **#:** *shutdown -y -g0 -i0* <enter>

You should see a lot of screen messages as the system goes through its shutdown procedures. Finally, the "ok" prompt should appear at the left, below the final screen message text. At this point it is safe to switch off the power to the three hardware components.

5.1.6 Turn Power Switches Off: Wait for the "ok" prompt before turning power switches off in this order:

1. CPU
2. Monitor
3. Hard Drive

REFERENCES

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